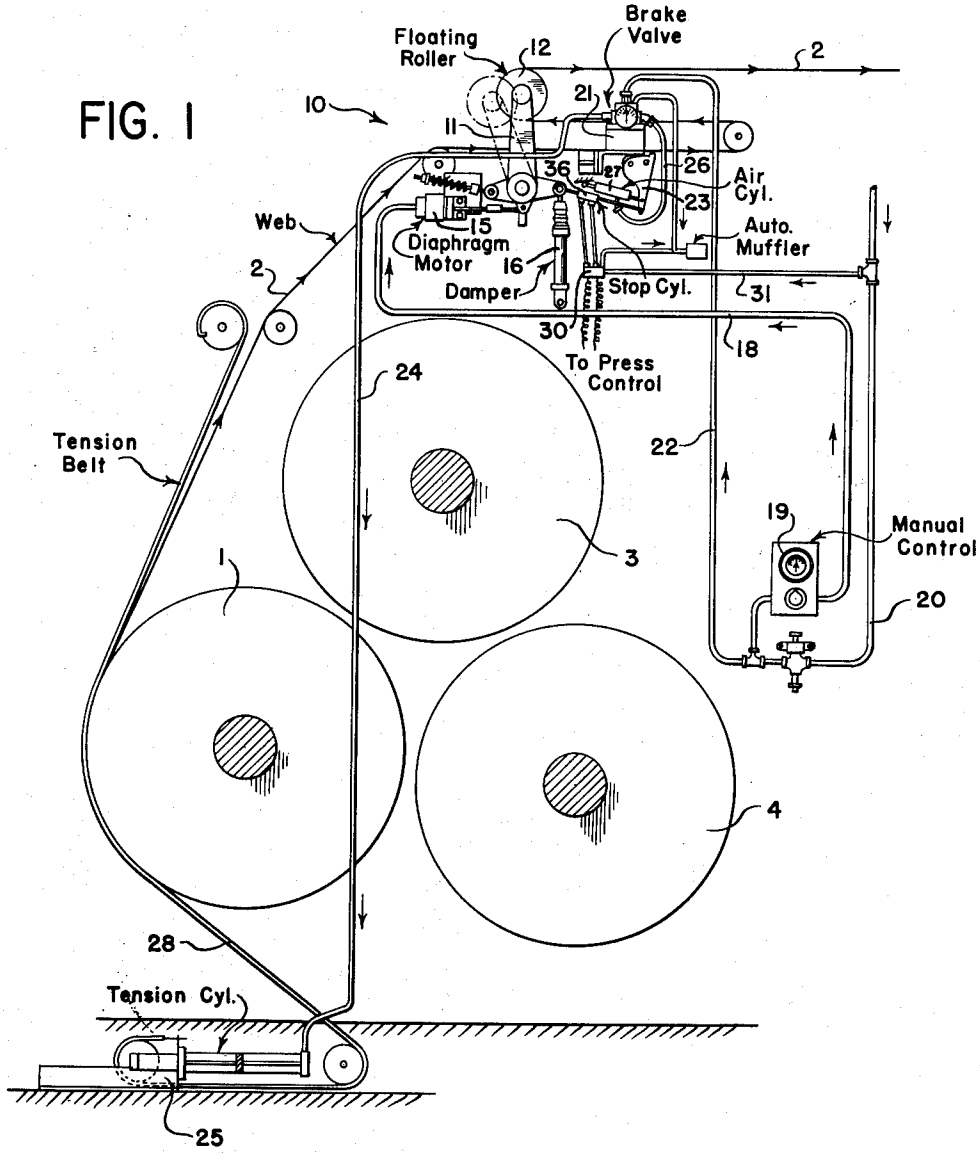
Oct. 30, 1962 A. L. PETERSON 3,061,227

WEB TENSIONING DEVICE

Original Filed Nov. 28, 1956 2 Sheets-Sheet 1

FIG. 1



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FIG. 2

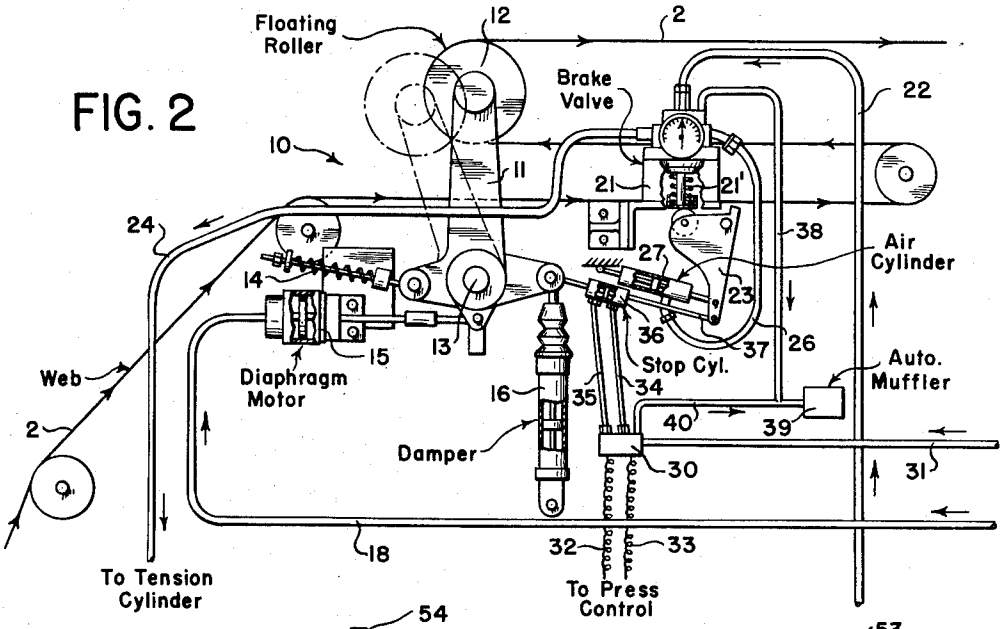


FIG. 3

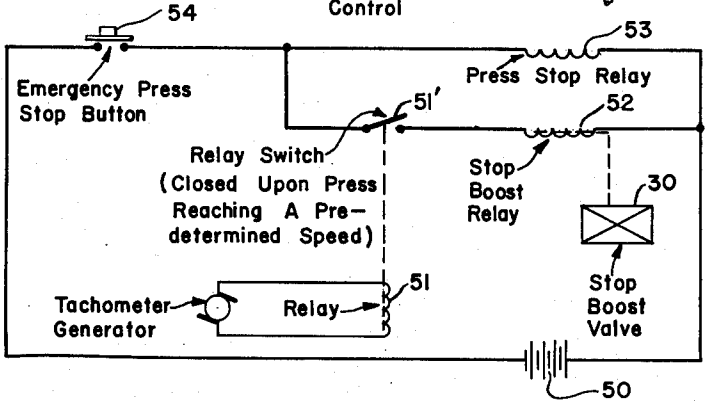
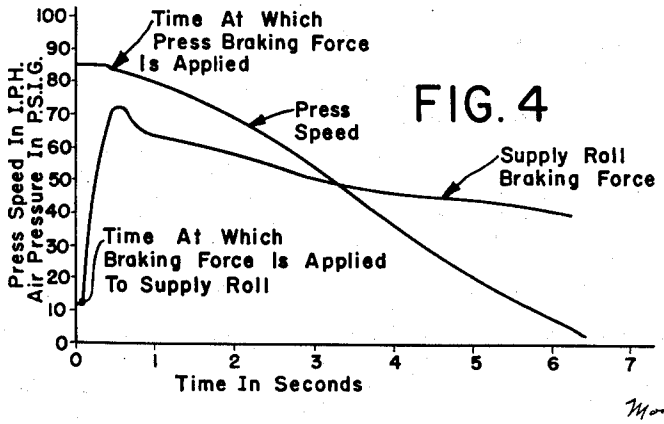


FIG. 4



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WEB TENSIONING DEVICE

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Continuation of application Ser. No. 624,790, Nov. 28, 1956. This application Dec. 20, 1960, Ser. No. 77,769

7 Claims. (Cl. 242—75.42)

This invention relates generally to a web tensioning device wherein constant tension may be maintained on a moving web of paper which is being fed to a press during the time the press is braked to an emergency stop. This application is a continuation of application Serial No. 624,790 filed by me on November 28, 1956 and entitled "Web Tensioning Device," now abandoned.

One of the requirements of efficient printing with high speed presses is that a constant tension be maintained on the web of paper moving to the press from a supply roll. If tension is not maintained between a relatively narrow range of limits, there is danger that the web of paper may break and so necessitate shutting down the press in order to re-thread it with a new supply of paper. If, for any reason, the press must be shut down quickly, as in the case of a "red button" or emergency stop, braking must be applied to the rotating supply roll in order that it may also be slowed down to prevent it from running in advance of the press.

Heretofore, the constant tension means used kept the tension of the web constant only when the press operated under normal running or normal deceleration conditions. The constant tension means comprised a control means, usually a floating roller, and means for applying a braking force to the rotating supply roller which was responsive to movement of the floating roll. During an emergency stop of the press, the supply roll was kept from running in advance of the press by applying an additional arbitrary braking force to the supply roll, which merely bypassed the normal tension control. This arbitrary braking force was determined by taking an average of different braking forces needed to prevent over feeding of the web to the press under different emergency stop conditions. However, the angle of wrap between the supply roll and brake straps varies as the roll is used up which in turn effects the overall braking force exerted on the supply roll so that tension of the web often would vary beyond the allowable limits during an emergency stop of the press and so cause a break in the web. Further, the inertia of the roll varies according to the roll diameter which effects the braking force required to bring the roll to a stop. It is, therefore, an object of this invention to provide means for maintaining constant tension on a running web under all operating conditions including a "red button" or emergency stop of the press.

Broadly, I propose to provide means for imparting an additional braking force to the rotating supply roll in advance of the receipt of an emergency stop signal by the press to overcome roll inertia and which does not bypass the normal tension control means. A web tensioning device in use today which maintains substantially constant tension on a web of moving paper under normal operating conditions comprises a floating roller mounted on a swinging arm over which the moving web passes. This swinging arm is positioned between the supply roll and the press. The arm is kept from swinging about its pivot point when no outside force is applied to it and is urged towards the vertical by means of a balance spring which overcomes the gravitational effect of the arm when it is out of vertical alignment. The arm moves a pneumatic means which comprises a variable pressure control valve which in turn imparts a braking force on the supply roll in response to movement of the swinging arm. I add

to this apparatus a second pneumatic means comprising a stop boost cylinder which operates to increase the braking force imparted by the above first mentioned pneumatic means in response to an emergency stop control. The emergency stop control is so connected with the circuit controlling the stoppage of the press that it is actuated before the press actually receives the emergency stop signal. The time difference between the boost breaking force being imparted to the supply roll and the stop signal received by the press is minute and on the order of ½ a second.

Referring to the drawings in which an embodiment of my invention is shown, FIG. 1 is a schematic side view of a tension control device constructed according to my invention as applied to a rotating supply roll;

FIG. 2 is an enlargement of a part of FIG. 1 showing the structure in greater detail;

FIG. 3 is an electrical diagram illustrating an electrical control circuit for controlling a tension control device constructed according to my invention; and

FIG. 4 is a graph illustrating press speed and braking force applied to the supply roll with respect to time.

Referring to the drawings in detail, **1** illustrates a supply roll from which a web **2** is unwound to run to a press, not shown. Rolls **3** and **4** are extra supply rolls which may be accelerated and brought into contact with the web of roll **1** by known methods so that the press may operate continuously without a shut-down for rethreading.

A tensioning control device denoted generally by **10**, comprises a rotatable arm **11** having mounted thereon a floating roller **12** over which the web passes. Arm **11** is rotatable about point **13** and the effective weight tending to rotate the arm when it is not in vertical alignment with the point **13** is overcome by means of a balance spring **14**. A diaphragm motor **15** moves the arm **11** as seen in FIG. 1, in response to air pressure exerted on it by means of manual control valve **19**, as will be explained more fully hereafter. The effect of this arrangement is that the same effort must be applied by motor **15** to move the arm **11** throughout its whole range of rotational movement. Thus, if the diaphragm motor **15** is not energized with any air pressure, the floating roller and arm will remain in any position at which they are left due to the balancing action of spring **14**.

A shock absorber or damper **16** is connected to one side of arm **11** to provide a damping or retarding effect in one direction only. The damper **16** allows the arm **11** to move forward freely in a counter-clockwise direction when the web tightens, so that it serves to prevent the arm from excessive hunting or over correcting in its automatic operation, as will be more fully explained.

Diaphragm motor **15** is connected by means of a conduit **18** to a manual pressure control valve **19** by which the web tension is regulated to a desired value. Manual control **19** in turn is connected by means of a conduit **20** to a source of compressed air not shown.

A variable pressure control or brake valve **21** is connected by means of conduit **22** to the same source of pressure as control valve **19**. Brake valve **21** has a pressure regulating spring **21'** which may be overcome by the lever **23**. When the lever **23** is depressed, air flows through conduit **24** to a tension cylinder **25** while at the same time, air passes through conduit **26** to an air cylinder **27**. This cylinder is positioned so that the regulated pressure fed to it comes from a down-stream port on the control valve so that the cylinder tends to shorten and so compensate for the energy required to compress the pressure regulating spring **21'** carried in the control valve itself.

Tension cylinder **25** operates to increase tension on brake belt **28** when air is forced into the cylinder from the control valve **21**. While I show a fixed brake belt, it

is obvious that the tension cylinder could be applied to a running system of brake belts which may pass over the roll **1**.

A four-way solenoid operated pneumatic stop boost valve **30** is connected to the source of pressure **20** by means of a conduit **31** as shown in FIG. 1. The solenoid stop boost valve **30** is also connected by means of wires **32** and **33** to the press control board and is actuated as will be explained hereafter. The stop boost valve **30** is connected by means of flexible conduits **34** and **35** to the stop boost cylinder **36**. When the solenoid operated stop boost valve **30** is energized, the blind end of stop boost cylinder **36** is purged and the rod end pressurized so that the overall effect is to shorten rod **37** which in turn will depress the lever **23** to allow boost air to be sent to tension cylinder **25** to overcome the inertia of roll **1** resulting from stoppage of the press. It is important to note that there is no required movement of the floating roller **12** in the increase tension direction at the instant rod **37** is shortened and that the loading or position of roller **12** remains the same. It is also important to note that by this system of shortening the rod **37**, the tension control means **10** has not been bypassed but merely operates brake belts **28** at a higher energy level of force and that arm **11** will still remain free to rotate to keep the tension of the web constant.

An exhaust conduit **38** allows air to be exhausted from control valve **21** through a muffler **39**. A conduit **40** serves to exhaust air from the stop boost valve **30** also through muffler **39**.

Referring to FIG. 3, there is illustrated schematically an electrical circuit by which a stop boost cylinder may be actuated prior to actuation of the brakes for braking the press. The electrical circuit comprises a source of electrical current **50**, a voltage sensitive relay **51** having a normally open switch **51'** which is connected to a tachometer generator on the press drive shaft and which will be closed when the press reaches a predetermined speed, a stop boost solenoid relay **52**, a press stop relay **53** and a press stop button **54**. Stop relay **53** controls other relays in cascade so that when it is energized, it will actuate the other relays to switch the press from "run" to "stop," dropping out all press drive components and applying a braking force to the press.

When the press is running at normal speed, relay **51** will be closed so that when the press stop button **54** is depressed stop boost valve **30** will be immediately energized by stop boost solenoid relay **52** to apply a boost pressure on the tension cylinder **25**. There will be a slight delay before the relays operating the press drive components and brakes are actuated due to their cascade arrangement with respect to press stop relay **53**. This delay is normally on the order of approximately ½ of a second.

When the press slows down to a predetermined speed, voltage relay **51** will open to de-energize the stop boost valve **30** to remove the boost pressure being applied to tension cylinder **25**. At the lower speeds after the press has decelerated sufficiently, the tension control **10** alone applies sufficient braking force on roll **1** to overcome the effects of roll inertia so that the boost braking force due to the shortening of rod **37** is no longer needed.

FIG. 4 is a diagram illustrating the application of braking force to supply roll and speed of the press in impressions per hour as compared with time. It is seen that braking force is exerted on the supply roll prior to any drop in press speed, and at about $\frac{1}{10}$ second after actuation of the press stop button, the maximum braking force is exerted on the supply roll. This increase of braking force overcomes roll inertia and allows the roll to be stopped under control so that tension of the web will remain substantially constant during the entire stopping period.

The operation of the device may be understood by referring to FIG. 1. The regulator **19** is adjusted to give a

desired pressure to diaphragm motor **15** which in turn will give the desired tension on web **2**. If the tension of the web decreases, diaphragm motor **15** will cause the floating roller **12** to move to the left to take up the decrease in tension. This in turn will depress the lever **23** which will allow compressed air to be passed through conduit **24** to tension cylinder **25**. As tension cylinder **25** is pressurized, it will increase the pull on belt **28** so that it will exert a greater braking force on roll **1** increasing the tension in web **2**. The floating roller will then end to move clockwise to compensate for the increase in web tension. When the press is at operating speed this automatic regulation is constantly taking place in small increments. The movement of the floating roller **12** is hardly discernible to the eye, yet it does move to supply the correct pressure in tension cylinder **25** to maintain constant web tension. For example, the air pressure on the pistons will gradually increase as the roll wears down so that when it becomes a butt, the air pressure exerted on the tension cylinders will be about double the amount as compared with the start of a fresh roll.

When the press must be stopped suddenly, the press stop button is pressed which will actuate solenoid stop boost valve **30**. The actuation of the solenoid stop boost valve **30** will take place approximately ½ of a second before the press drive is disconnected and before the brakes are applied to the press due to the circuitry of the electrical system. When the four-way solenoid valve **30** is energized, the blind end of stop cylinder **36** is purged and the rod end pressurized reducing the overall length of connecting rod **37**. This in turn will move lever **23** which will allow additional boost pressure to be exerted on tension cylinder **25** thus boosting the braking force on supply roll **1** before the brakes are applied to the press. It is important to note that the loading of the floating roller **12** is not changed or bypassed and that this floating roller still controls tension of the web since it is still free to rotate about point **13** during the entire stopping period. Any movement of the roller about point **13** will continue to move lever **23** as previously described to compensate for any change in web tension. Shortening of rod **37** merely shifts the braking force of belt **28** to a higher energy level to compensate for the inertia of the roll.

It is to be understood that the particular schematic electrical diagram of FIG. 3 is merely illustrative of how the automatic tension device of my invention might be connected in with a press and that individual presses might require different circuitry in order to allow actuation of the stop boost valve before the press drive is dropped out.

It is thought that the invention and its many attendant advantages will be understood from the foregoing description and that it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the scope of the invention.

I claim:

1. A web tensioning device for controlling tension of a web running between a machine using said web and a rotating supply roll of web material comprising, floating roller means contacting said web, load means for biasing said roller means in a direction to impart tension in said running web, brake means controlled by said floating roller for imparting a variable braking force on said rotating supply roll to maintain substantially constant tension in said web when said machine is using said web at a desired running speed, and stop boost means for increasing to a higher energy level the braking force exerted on said rotating supply roll by said brake means when said machine using said web is deenergized while permitting said floating roller to continue its control of said brake means so that said brake means continues to impart a variable braking froce on said rotating supply roll to maintain substantially constant tension in said running web during the complete stopping cycle of said machine.

2. A web tensioning device according to claim 1 wherein said stop boost means is operative only during the first portion of the stopping cycle.

3. A web tensioning device for maintaining substantially constant tension of a running web extending between a rotating supply roll of web material and a press using said web during a fast stop of said press comprising, a floating roller, load means for biasing said roller in a direction to increase tension in said web, a variable pressure control valve connected to a source of pressure and operated by movement of said floating roller, pressure operated brake means connected to said variable pressure control valve for imparting a braking force on said rotating supply roll to maintain substantially constant tension in said web when said press is running at a desired speed, and stop boost means operable directly on said variable pressure control valve during a fast stop of said press to cause said variable pressure control valve to increase pressure to said pressure operated brake means while at the same time permitting said floating roller to operate said variable pressure control valve to actuate said pressure operated brake means.

4. A web tensioning device according to claim 3 wherein said floating roller comprises a vertically extending arm pivoted for rotation at its bottom end and having a roll at its other end contacting said web, and having in addition spring means for overcoming the force of gravity acting on said arm and roll urging said arm to rotate about its pivoted end when said arm and roll are out of vertical alignment.

5. A web tensioning device according to claim 4 wherein said stop boost means is operative only during the initial portion of the time from when a signal is given to stop the press and the press comes to a complete stop.

6. A method of maintaining substantially constant tension on a moving web of web material extending between a running press and a braked rotating supply roll of web material during a first period of normal press operation and during a second period in which the press is brought to a stop so that said supply roll does not overrun said press during said second period comprising the steps of applying a braking force to said rotating supply roll, continuously varying said braking force inversely with changes in tension of said web during said first and second periods, and increasing said braking force applied to said rotating supply roll during said second period.

7. A web tension device for maintaining substantially constant tension of a running web extending between a rotating supply roll of web material and a press using said web during a fast stop of said press comprising, a floating roller having a vertically extending arm pivoted for rotation at its bottom end and having a roll at its other end contacting said web, and having in addition spring means for overcoming the force of gravity acting on said arm and roll urging said arm to rotate about its pivoted end when said arm and roll are out of vertical alignment, load means for biasing said roller in a direction to increase tension in said web, a variable pressure control valve connected to a source of pressure and operated by movement of said floating roller, pressure operated brake means connected to said variable pressure control valve for imparting a braking force on said rotating supply roll to maintain substantially constant tension in said web when said press is running at a desired speed, and stop boost means comprising a pneumatic stop boost cylinder having slidable therein a rod, a lever connected to said rod for operating said variable pressure control valve, and a solenoid operated valve for controlling admission of pressure from said source to either end of said cylinder whereby said rod may be moved in a direction to actuate said lever so as to cause said variable pressure control valve to increase pressure to said pressure operated brake means while at the same time said floating roller continues to operate said variable pressure control valve to actuate said pressure operated braking means.

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